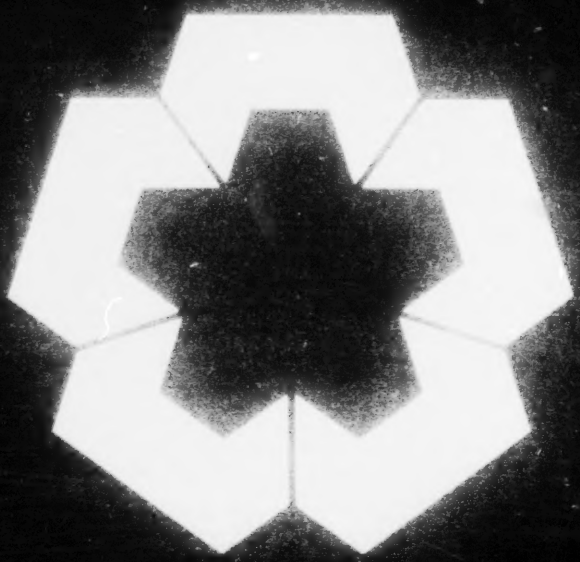

An Assessment of Collection and Handling of Climate Data By Alberta Government Agencies

RMD Report 82/12

Alberta
ENVIRONMENT
RESEARCH MANAGEMENT DIVISION

RESEARCH MANAGEMENT DIVISION LOGO

The logo represents the interdisciplinary and holistic nature of the Division's environmental research programs. Each of the five sections of the symbol represent comprehensive programs on air, water, land, humans, and their constant interaction. The sections converge to form a cohesive chain, characteristic of an effective research organization. This cohesive bonding makes the sections blossom into the environment in the form of a flower — an Albertan wild rose.

AN ASSESSMENT OF COLLECTION AND HANDLING OF CLIMATE DATA BY ALBERTA GOVERNMENT AGENCIES

RESEARCH MANAGEMENT DIVISION
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by

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Division of Bow Valley Resource Services Ltd.

for

Research Management Division
Alberta Environment

RMD 82/12
January 1983

This report is made available as a public service. The Department of Environment neither approves nor disagrees with the conclusions expressed herein, which are the responsibility of the authors.

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ABSTRACT

A survey of climate data collection activities by provincial government agencies in Alberta was undertaken to evaluate the present state of collection programs and make recommendations for future co-ordination. There are presently thirteen agencies collecting climate data. Communication of information on collection activities is not well developed. Data collected by each agency are generally not conveniently available for use by others. Establishment of a data management system for the exchange of data and information on collection programs is recommended.

ACKNOWLEDGEMENTS

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1. INTRODUCTION

The Canadian economy relies heavily on natural resource utilization, and is therefore dependent on climate. Continued success in natural resource-based segments of the economy as they exist today depends on climate stability. To make prudent decisions and policies concerning the future of these segments, climate considerations, such as climate changes, must be taken into account.

The Canadian Climate Centre was established in the spring of 1978 to initiate a program to improve our understanding of climate and help Canadians make the most effective use of climate resources and information. It has been recognized that federal and provincial co-operation is necessary to efficiently fulfil these goals.

Areas of the Alberta economy which are most likely to be affected by climate change have been discussed by Leggat (1981). These include forestry, agriculture, water resources, and recreation. One of the first priorities for attempts to counter the impacts of climate change is an improved data base (Leggat 1981). Improved climatic forecasts and efficient policies for resource management would follow.

An improved data base for climate information would benefit other activities in addition to the evaluation of climate change. Better decisions by planners in the areas of transportation, recreation, engineering design, and resource production can be made if climate factors can be taken into account. Research studies involving climate factors can be performed more rigorously and efficiently if all applicable climate data are readily available.

As a first step toward an improved data base, Western Research was contracted by the Research Management Division of Alberta Environment to define the current state of climate data collection by provincial government agencies and to make recommendations for future co-ordination. Specific objectives of this project include:

1. Determine which agencies are involved in climate data collection programs.
2. Determine the types of data collected by each agency, including the climate variables being measured; the

number and location of the sites at which the variables are being measured; the frequency of measurement; the type of instrumentation involved; and the purpose for collecting the data.

3. Determine the ways in which each agency is archiving the data collected, and the ways in which the data are presently being made available to other users, both within and outside of government agencies.
4. Determine the appropriateness and feasibility of establishing a common data bank for the storage and retrieval of climate data collected by government agencies. This determination should address resource requirements, including manpower, to establish and maintain such a data bank.
5. Provide recommendations for the co-ordination of climate data collection activities by government agencies. Recommendations should address cost effectiveness and collection redundancy.

2. APPROACH

An interview approach was adopted to obtain information from government agencies on their involvement with climate data.

A list of questions was prepared to serve as a guide for discussion during interviews. Questions covered a wide range of topics, including purpose of data collection and use of data; details of monitoring programs and data handling; future needs requiring climate data; exchange of information between agencies; and opinions regarding establishment of a common archive, its role, and desired user features. The list of questions is included in the Appendix. By learning as much as possible about an agency's involvement with climate data, insights useful in making recommendations for an improved data base were obtained.

Most interviews were conducted in person, some by telephone, and in a few cases by obtaining written responses. Initial contacts for interviewing were obtained from the list of contributors given by Leggat (1981). Additional contacts were recommended by each interviewee. People contacted included researchers, technicians, forecasters, planners, and administrators. A list of people and agencies contacted is available from Alberta Environment, Research Management Division. Questions in the interview guide were not all applicable to each interviewee, as interviewees' experience with climate data varied over a wide range.

Results of the discussions are summarized in the following sections.

3. CLIMATE DATA PROGRAMS IN ALBERTA

3.1 COLLECTION OF CLIMATE DATA

A total of 13 government agencies collecting climate data in Alberta have been identified. Table 1 presents a list of these agencies in alphabetical order by department, and a brief description of their purpose for collecting data. Alberta Environment and Alberta Energy and Natural Resources are the two departments most heavily involved in climate data collection. They have four and three agencies, respectively, which collect climate information.

All agencies listed in Table 1 use data in an historical sense for research projects or case study analyses. Four agencies (Alberta Forestry Service Protection Branch, Flow Forecast Centre, Outdoor Recreation and Planning Branch, and Atmospheric Sciences of the Alberta Research Council) also use information on a real time basis during appropriate seasons of the year for operational aspects of their work.

Table 1 also presents a summary of climate parameters measured and the number of monitoring stations operated by each agency. The Protection Branch of Alberta Forestry Service monitors the largest geographical area. The Pollution Control Branch of Alberta Environment monitors the widest range of climate variables. Details of monitoring networks provided by all agencies are available from Alberta Environment, Research Management Division.

3.2 HANDLING OF CLIMATE DATA

Data handling procedures of each agency vary according to how data are used. A summary of how observations are recorded, transmitted, analysed, filed, and made available for outside use was obtained for each agency.

Table 1. Summary of climate data collection by Alberta Government agencies.

Agency	Primary Purpose(s)	Summary of Parameters Routinely Monitored	Approximate Number of Sites
Engineering Resource Branch, Alberta Agriculture	Short research projects	humidity precipitation pressure solar radiation temperature winds	1
Soils Branch Plant Industry Division Alberta Agriculture	Research for evaluation of deep plowing	precipitation	28 (variable)
Land Use Branch Alberta Forestry Service Alberta Energy and Natural Resources	Research into effects of forest management on water cycle	precipitation	157
Protection Branch Alberta Forestry Service Alberta Energy and Natural Resources	Forest fire monitoring Forest fire research	cloud cover humidity precipitation snow pack temperature visibility winds	270

continued...

Table 1. Continued.

Agency	Primary Purpose(s)	Summary of Parameters Routinely Monitored	Approximate Number of Sites
Resource Appraisal Section Resource Evaluation and Planning Division Alberta Energy and Natural Resources	Inventory of climate resources Evaluation of agricultural potential	precipitation snow pack air temperature soil temperature	100
Air Quality Control Branch Pollution Control Division Alberta Environment	Assess ambient air pollution levels Atmospheric dispersion studies	humidity pressure snow pack solar radiation surface temperatures upper air temperatures turbulence horizontal winds vertical winds upper air winds	93
Research Management Division Alberta Environment	Provision of data base for environmental research in Athabasca oil sands area	humidity precipitation snow pack temperature winds	29

continued...

Table 1. Continued.

Agency	Primary Purpose(s)	Summary of Parameters Routinely Monitored	Approximate Number of Sites
River Forecast Centre Technical Services Division Alberta Environment	Flood forecasting Water supply forecasting	humidity precipitation snow pack temperature	146
Survey Branch Technical Services Division Alberta Environment	Hydrology research	evaporation precipitation sunshine temperature	146
Alberta Hail and Crop Insurance Corporation	Operation of weather-based insurance program for hay and pasture crops	precipitation	1 049 (variable)
Planning Branch (Parks) Design and Implementation Division Alberta Recreation and Parks	Provision of a data base for park resource management and seasonal advisories for natural hazards	cloud cover precipitation snow peak temperature	4
Atmospheric Sciences Department Alberta Research Council	Cloud physics research Operation of cloud seeding program for hail suppression	hail intensities precipitation upper air temperatures upper air winds	500 (variable)

(continued)...

Table 1. Concluded.

Agency	Primary Purpose(s)	Summary of Parameters Routinely Monitored	Approximate Number of Sites
Solar and Wind Energy Research Program Alberta Research Council	Provision of data base for assessment of solar and wind energy potential in Alberta	solar radiation temperature wind	7

3.2.1 Alberta Agriculture

3.2.1.1 Engineering Resource Branch. Climate data are collected for periods of two to three months in duration, for special research projects, using a mobile trailer. Information is recorded on cassette tape by an automatic data logger. All analyses and storage of data are done by computer.

3.2.1.2 Soils Branch, Plant Industry Division. The Soils Branch makes use of data from two sources: 1) data obtained in summary form from the federal Atmospheric Environment Service (AES), and 2) collected precipitation data.

Synoptic data and weekly summaries published by AES are used to prepare bi-weekly agroclimatic summaries, which are distributed to various sectors of the agriculture industry.

Precipitation is observed during summer months with a network of rain gauges monitored by farmers. Information is used in evaluating the effect of deep ploughing on soil fertility in areas of solonetzic soils.

Precipitation is also recorded in selected areas during the growing season by Branch personnel as part of a Risk Adjusted Yield Potential Project for cereal and oilseed plots.

Analysis of data from both sources involves a combination of manual and computer evaluations. Information is presently stored in hard copy form. Requests for data are usually agriculture-oriented and easily satisfied with the summaries. Plans are under way to set up a system of computer storage.

3.2.2 Alberta Energy and Natural Resources

3.2.2.1 Land Use Branch, Alberta Forestry Service. Climate information is collected to evaluate the impact of forest management strategies on the water cycle and the forest ecosystem. Data are recorded automatically on hard copy and analysed manually. Most of

the information is filed in hard copy form. A small fraction is stored on computer. Future changes will involve more computerization.

3.2.2.2 Protection Branch, Alberta Forestry Service. The Protection Branch of the Alberta Forestry Service collects climate data for monitoring of forest fire hazard throughout the province during summer months, and for ongoing research into factors which affect forest fire potential. Synoptic weather observations of the AES are used during summer months in preparation of weather forecasts used in support of protection operations.

Climate data are observed manually in the field and reported to regional offices via radio. Regional information is tabulated and transmitted to both the Branch headquarters and the AES forecast office in Edmonton via teletype, where it is analysed manually for operational use. In the Branch headquarters, data are keypunched for storage on computer. Hard copies are also filed.

Monthly summaries of daily precipitation and temperatures are tabulated in the field at ranger stations, and at the Branch headquarters for lookout towers. These data are then forwarded to AES where they are keypunched into the archive and published in summary form.

Future trends in data handling will be toward implementing a computerized data management system. Details of such a system are presently undecided. There is merit in manual analysis of data, however, as personal intuition is important in evaluation and quality control. The real advantage of automation will be in data management.

The system of storage for climate data at the Branch was designed for internal needs of the Branch, and to this end the system is adequate. Outside users of the data do not have access to this system. Data can be supplied to them by three possible means: manual abstraction from hard copy, photocopy of hard copy (if manpower resources are available), or summaries published by AES.

3.2.2.3 Resource Appraisal Section, Resource Evaluation and Planning Division. Climate data are collected for use in the evaluation of agricultural potential in regions where land use plans are being prepared.

Data are recorded automatically on strip charts, which are then transferred to the Section office for calibrations, corrections, and digitizing. A computerized analysis and storage system has been designed and is currently being implemented. When this system is operating, data will be analysed by computer and will be archived on computer in the same format as AES daily summaries. Original raw data will be filed in hard copy as back-up.

A backlog of about three years of raw data exists at the present time. This information is available to outside users. Information will be available in summary form or in computer format when the computerized system is implemented.

3.2.3 Alberta Environment

3.2.3.1 Air Quality Control Branch, Pollution Control Division.

The Air Quality Control Branch works with climate data from two broad categories: data collected by the Branch itself, and data collected by industry and reported monthly to the Branch in compliance with licenses to operate.

The Branch collects data routinely for two primary purposes: to generate a suitable diffusion climatology for driving models used in air quality management, and to monitor urban air quality in the cities of Calgary and Edmonton.

Climate data collected for dispersion studies are summarized on hard copy at the site and later keypunched into the computer. This task requires about two hours per day. All analysis is done by computer. It is anticipated that hard copies and key punching will eventually be replaced by a direct link to the computer.

Information from the urban air quality monitoring sites is at present recorded automatically and stored on floppy disk at each site.

In future, a central computer dial-up system will be implemented. Data will then be transmitted directly to a central computer via telephone lines, with multi-pen recorders on site as back-up. Urban air quality data are analysed once a year by computer to prepare monthly, quarterly, and annual summaries of air pollution for Calgary and Edmonton.

Reports from industry are received in hard copy form once per month. They contain summaries of hourly and daily averages for windspeed, wind direction, and various parameters for which monitoring is required. These reports are reviewed manually and then filed in the original hard copy form for two years, and then on microfiche.

The methods of data handling at the Branch are sufficient for internal needs. A system for efficiently retrieving or distributing data does not exist. As a result, many requests to the Branch which would require data preparation or evaluation are turned down because manpower, facilities, and resources are not available.

Requests for raw data are usually fulfilled by providing photocopied or computer-generated hard copies. Occasionally data are supplied on computer tape.

3.2.3.2 Research Management Division. The Research Management Division collects climate data in the Athabasca oil sands area of northeastern Alberta to establish a baseline climatology of the region for evaluating the impact of potential large-scale industrial developments.

Routinely collected climate data are recorded automatically in the field on strip charts, computer hard copy, or cassette tape. Analyses are performed only for special research studies, in which cases the results are published. Studies presently under way include analysis of the Modular Aquisition Processing System (MAPS) network data and snow course data.

All raw information is available to interested users; however, they must abstract and process data on their own. Two main disadvantages to this system of data handling are bulkiness of non-

computerized data, and difficulty and inconvenience of data abstraction. A computerized storage and retrieval system is planned for the future.

3.2.3.3 River Forecast Centre, Technical Services Division. Climate data are collected by the River Forecast Centre for routine monitoring of conditions related to, and forecasting of, water supply and flood potential in river systems of the province.

Most data are recorded automatically and relayed to the Centre office in Edmonton via satellite transmission or telephone link. Hard copy back-up is generated at stations serviced by telephone link. Data are analysed manually by plotting to obtain input for a computer model which estimates streamflows. Raw data are stored on floppy disk for three months and then transferred to computer tape. Hard copy is destroyed once proper storage has been verified. In future it is planned that the number of monitoring stations, use of satellite communication, and use of automated data management will increase.

Data handling by the Centre is satisfactory for its internal needs. Data can be made available to outside users; however, the facilities and resources do not exist to do this efficiently in a routine manner. The Branch feels that the number of data requests it receives would increase if information were more conveniently accessible.

3.2.3.4 Survey Branch, Technical Services Division. The Survey Branch collects precipitation and evaporation related data to evaluate water balance in drainage basin headwater regions where research work is being done. The Branch also has complete records on computer tape in daily summary format for all AES stations in the province. This information is used for routine hydrological evaluations provided by the Branch.

Climate data are recorded automatically in the field, and are forwarded to the Branch office in Edmonton on strip charts. Abstraction and analysis are done manually, and tabulated results are stored in hard copy form. Data are published or archived if the means

to do so exist. For example, some snow pack data are stored on tape because the program to process it exists, and precipitation data which meets AES standards are published by AES.

Data handling by these methods is adequate for the amount of data being handled at the present time. Use of automated techniques is planned for the future. The data transmission system being implemented by the River Forecast Centre will be utilized, and computer storage and analysis will be implemented.

3.2.4 Alberta Hail and Crop Insurance Corporation

The Alberta Hail and Crop Insurance Corporation collects daily rainfall data during summer months from a network of stations operated by farmers participating in the program. In 1981 there were about 1000 stations. This information is used in conjunction with selected climate data from AES observing stations, to evaluate crop conditions over the growing season, and to simulate crop weather conditions over the past 25 to 30 years.

Precipitation data are observed manually in the field and reported by postcard to the Corporation office in Lacombe. AES station report summaries are received on photocopies. Data are keypunched, then quality controlled and corrected on-line, and analysed by computer. Suggested improvements in data handling include the elimination of manual data handling by obtaining AES summaries in a computer compatible format, and by using an optical card reader for precipitation reports.

Precipitation data are available to outside users on computer tape.

3.2.5 Planning Branch (Parks), Design and Implementation Division, Alberta Recreation and Parks

The Planning Branch collects climate data at one location in four provincial parks. The information is used to establish baseline conditions for use in park management decisions, and to provide

advisories for park users on natural hazards such as fire, avalanche, or road conditions.

All aspects of data handling are manual, and information is stored in hard copy form at the various park offices. Monthly summaries of daily observed data are forwarded to AES for publication. People with requests for data are usually referred to these publications. In the future, data may be put onto computer cards. The present data handling system is simple, yet inexpensive and manageable due to the small amount of data.

3.2.6 Alberta Research Council

3.2.6.1 Atmospheric Sciences Department. The Atmospheric Sciences Department of Alberta Research Council (ARC) collects climate data in support of weather modification research, with operational aspects involving hail suppression and rain and snow pack augmentation.

Monitoring programs are of two types: routine and non-routine. Data are collected routinely from early June to early September for operational use. These include measurements of radar reflectivity, rawinsonde parameters, rainfall, and hail. Data are collected non-routinely during intensive two or three day field studies throughout the summer period. These may consist of pibal releases, precipitation intensity measurements, and non-scheduled rawinsonde releases at various locations. Synoptic weather observations of the AES are used during summer months for monitoring and forecasting meteorological conditions, and planning cloud seeding operations.

Various people are responsible for data collection programs described above. A data management system does not exist for the Department. Radar reflectivity measurements, which can be used to provide information on precipitation, are stored directly on computer tape and analysed by computer. All other observations are recorded manually and stored in hard copy. They are keypunched for temporary use if required for case study analysis, otherwise data remains stored on hard copy.

3.2.6.2 Solar and Wind Energy Research Program. The Solar and Wind Energy Research Program was initiated in 1977 with two purposes: to bring together all available literature on solar and wind energy in Alberta, and to monitor solar and wind energy within the province to evaluate potential utilization. From 1979 to the present, the program has monitored at only four stations. Now that a data monitoring system is in place, the network will be expanded.

Raw data are automatically recorded on cassette tape in the field, and collected by ARC once per month. Summaries are generated by computer. Information will be archived on tape in a format similar to that of AES starting sometime in 1982. Until then, information will be available only in the form of summaries.

3.2.7 Summary of Comments on Data Handling

Techniques used by provincial government agencies in handling climate data cover a spectrum of sophistication levels ranging from completely manual to nearly complete automation. Table 2 summarizes the modes and methods of data recording, transmission, analysis, storage, and availability to outside users. Raw data are recorded automatically by most agencies. Analyses are done manually, by computer, or with a combination of the two. Hard copy is the most common mode for storage and availability. In future, most agencies are planning more use of automated collection and computer based methods for analysis and storage of data.

Table 2. Summary of data handling methods for each agency.

Agency	Recording/ Transmission	Analysis	Storage	Availability
Engineering Resource Branch Alberta Agriculture	electronic & strip chart	computer	computer	N/A
Soils Branch Plant Industry Division Alberta Agriculture	hard copy	manual & computer	hard copy & computer	hard copy summaries
Land Use Branch Alberta Forestry Service Alberta Energy and Natural Resources	hard copy	manual	hard copy	hard copy
Protection Branch Alberta Forestry Service Alberta Energy and Natural Resources	manual/ electronic	manual	computer & hard copy	hard copy AES summaries
Resource Appraisal Section Resource Evaluation and Planning Division Alberta Energy and Natural Resources	hard copy (strip charts)	(computer):: manual	(computer):: hard copy backup	(computer):: hard copy

continued...

Table 2. Continued.

Agency	Recording/ Transmission	Analysis	Storage	Availability
Air Quality Control Branch Pollution Control Division Alberta Environment	electronic & hard copy	computer & manual	computer & hard copy	computer & hard copy
Research Management Division Alberta Environment	strip chart hard copy electronic	computer computer	raw form	raw form computer tape hard copy
River Forecast Centre Technical Services Division Alberta Environment	electronic (hard copy backup)	manual & computer	computer hard copy backup	
Survey Branch Technical Services Division Alberta Environment	hard copy (strip charts)	manual	hard copy	hard copy AES summaries
Alberta Hail and Crop Insurance Corporation	hard copy	computer	computer	computer
Planning Branch (Parks) Design and Implementation Division Alberta Recreation and Parks	manual	manual	hard copy	AES summaries

continued...

Table 2. Concluded.

Agency	Recording/ Transmission	Analysis	Storage	Availability
Atmospheric Sciences Department Alberta Research Council	electronic hard copy	computer manual	computer hard copy	computer hard copy
Solar and Wind Energy Research Program Alberta Research Council	electronic	computer	computer	summaries

:: in the process of implementing

3.3 FUTURE NEEDS FOR CLIMATE DATA

Evaluation of climate data collection programs should include possible future activities requiring climate data. Each agency was asked to describe the immediate needs for which climate data would be required. Table 3 presents a summary of responses. Immediate and foreseen needs requiring climate data are wide in scope and generally unique to each agency. Fulfilling these needs will generate much more recorded climate data than exists at the present time.

Table 3. Climate data requirements for each agency.

Agency	Immediate Foreseen Needs
Engineering Resource Branch Alberta Agriculture	More site specific climate information.
Soils Branch Plant Industry Division Alberta Agriculture	More site specific climate information for evaluation of crop progress and local agricultural problems.
Land Use Branch Alberta Forestry Service Alberta Energy and Natural Resources	More rainfall intensity data for evaluating responses of forest ecosystem to precipitation. Evaluation of roles of wind and solar radiation on evapotranspiration in forested areas.
Protection Branch Alberta Forestry Service Alberta Energy and Natural Resources	Ongoing evaluation of precipitation deficit. Winter temperature and precipitation information to assess the effectiveness of snow cover in recharging soil moisture. Further evaluation of climate conditions which affect forest fire hazard.

continued...

Table 3. Continued.

Agency	Immediate Foreseen Needs
Land Management and Development Branch Public Lands Division Alberta Energy and Natural Resources	Wind data for identifying erosion and industrial emission hazards. Precipitation and temperature data for integrating with agricultural capability. Research into effects of man's large scale activities on local climate; i.e. oil sand development, interbasin water transfer, drainage projects, large scale clearing of lands.
Resource Appraisal Section Resource Evaluation and Planning Division Alberta Energy and Natural Resources	Broader data base for parameters required to evaluate agricultural potential, particularly solar radiation and improved soil moisture measurements.
Air Quality Control Branch Pollution Control Division Alberta Environment	A better understanding of turbulence and diffusion in the mountains and foothills for industrial design. A provincial climatology of air quality for planning purposes. A provincial climatology of dispersion parameters for stack design and air quality modelling. A greater understanding of the dynamics associated with the chinook winds and their effect on air quality.

continued...

Table 3. Continued.

Agency	Immediate Foreseen Needs
Research Management Division Alberta Environment	Study of methods for determining heat flux. Joint use of chemistry with climatological data in air pollution studies. Extension of dispersion and climatological studies in the AOSERP region to the entire province.
River Forecast Centre Technical Services Division Alberta Environment	Investigation of the relationship between radiation and snow melt. Investigation of potential for remote sensing to estimate snow cover and snow pack parameters.
Survey Branch Technical Services Section Alberta Environment	Verification of hydrology models. Research to increase knowledge of hydrological processes. Determination of the influence of climate on streamflow in order to extrapolate or interpolate streamflow chronologically and geographically.
Alberta Hail and Crop Insurance Corporation	A denser network of precipitation measurements.
Planning Branch (Parks) Design and Implementation Division Alberta Recreation and Parks	Research into prediction of natural hazards such as forest fires and avalanches.

continued...

Table 3. Concluded.

Agency	Immediate Foreseen Needs
Atmospheric Sciences Department Alberta Research Council	Data on rainfall for calibrating radar measurements. A cloud population climatology. Research into factors contributing to snowpack augmentation.
Environment Council of Alberta	A larger data base is needed, particularly from eastern slopes and northern areas for planning purposes and management decision making. Investigation of relationship between soils to climate.

4. EFFICIENCY AND COST EFFECTIVENESS IN CLIMATE DATA COLLECTION

In order for climate data collection to be efficient and cost-effective, there should exist a degree of co-ordination among collection programs, and applicable data should be available for use in evaluations where climate factors are important. This section addresses efficiency and cost-effectiveness in climate data collection programs by Alberta provincial government agencies.

4.1 EXCHANGE OF CLIMATE DATA AT PRESENT

Exchange of raw data occurs routinely among three provincial agencies, the Alberta Research Council (through the Alberta Hail Project), the Protection Branch of Alberta Forest Service, and the River Forecast Centre of Alberta Environment. These agencies make use of exchanged information in conjunction with weather observations of the federal Atmospheric Environment Service for real time use in operational aspects of their work. Information exchange is generally facilitated by accessing raw data communication lines.

Almost all agencies make routine use of climate information from the federal Atmospheric Environment Service in the form of published summaries, special reports, or data from the computer archive. This information is applied in many different ways, and comprises varying proportions of the entire data set with which each agency works. Factors which make AES data desirable to use include completeness of records in space and time, availability, ease of access and consistency of format.

Several agencies contacted expressed very strongly a need for improved access to climate data, and for data more representative of local regions or specific sites. This need is also experienced by the private sector. Many requests received by government agencies for climate data originate from individual citizens, environmental groups, consultants, or corporations. These needs remain largely unfulfilled for various reasons, including: lack of collection

programs, lack of information about details of existing programs, unavailability of summaries of existing data in a general form, and inconvenience of access to existing raw data.

In cases where collection programs do not exist, and detailed climate information is required, data may be collected for a short period of time either by the private sector at its own expense, or by a government agency. Examples of these situations are the assessment of environmental impact in remote areas and site specific research projects. Climate data collected under these circumstances are valuable as they are often very detailed, represent baseline condditions, and may be the only data available in the area. Unfortunately, such information is seldom used after its initial application. Reasons for this include lack of knowledge about its existence, and inconvenient access to the raw data.

In general, exchange of climate data between provincial government agencies, other than raw data for real time use as described, does not occur frequently. Evaluation of climate data can provide valuable input into planning, management, industrial design and environmental impact assessment. Exchanges of climate data would occur more often with increased communication on collection programs and improved availability of data.

Communication on climate data collection programs could be improved with a central index or directory containing details of collection activities by all agencies. Complete formal documentation encompassing all aspects of data collection, including philosophy, purpose, network design and implementation, data collection and reduction techniques, and data storage and retrieval, does not exist for most agencies. Rather this information usually resides in the personnel within each agency, or in some cases it is only partially documented for use inside the agency. Communication on climate data collection throughout all agencies in the provincial government would improve if complete and formal documentation of all related collection activities was centrally available.

Availability of climate data could be improved with recognition that cataloguing and storage of information with the aim of convenient and timely retrieval for future use is a logical final step in the data handling process. Each agency collecting climate data does so to fulfill a responsibility under its mandate. Internal systems of data handling are generally designed for fulfillment of these responsibilities in an efficient and cost-effective manner. Storage and retrieval of data for requests originating outside an agency are not usually part of a mandate, and therefore generally are not incorporated into data handling systems. Attempts to fulfill such requests often strain manpower resources within an agency and, as a result, some requests are turned down. Climate data should be available to all interested users. It should especially be available to the private sector as funding for collection programs comes from the private and public sectors. Improved availability of climate data would result in wider use of the data and improved cost-effectiveness of collection programs.

4.2 THE CONCEPT OF A COMMON INFORMATION BANK

Communication of information on climate data collection programs and availability of data have been identified as two areas where improvements could be made in promoting the exchange of climate information among agencies. The improvements could be made with the establishment of a common information bank for documentation and climate data from all provincial government agencies collecting climate data.

Bringing together of complete and detailed documentation of collection programs and data handling within each agency in a clear and consistent format would improve communication of climate data collection programs through all government agencies. Documentation would include details concerning purposes, networks, instrumentation, observations, reduction procedures, and data storage and retrieval. It would be presented in a form whereby a user could tell what data

are available, whether or not they could be used to meet his needs, and how they could be obtained.

Complete, centralized documentation would make agencies more aware of climate data collection programs in operation. Such awareness would help prevent duplication of monitoring by different agencies, perhaps increase co-operation in field maintenance and raw data exchange, and help users to more efficiently plan their research needs by knowing what programs already exist.

Documentation could be expanded to include a summary of experiences and recommendations by each agency concerning the operational aspects of their program in such areas as instrumentation, data reduction techniques, or quality control measures. This information would aid in the efficient planning of future collection activities.

Availability and accessibility of climate data would be improved if all data were brought together in one storage system. Such a system would contain all provincial government climate data, centrally located, catalogued, cross referenced, documented, and consistently formated. The system would have a flexible design so that data from future programs and non-government sources can easily be included. A computer-based system is mandatory because of the bulk of data which is available.

There are many advantages to having a centralized storage system for climate data. Data collected by all agencies would be available in a manner more convenient than at present. Data collected for short term periods or in remote areas for environmental impact assessment or special projects should then be properly filed, thus enhancing the potential for its utilization. A central system would be cost-effective in reducing manpower and financial requirements by each agency to maintain its own storage and retrieval facilities. The potential for higher quality data analyses would increase as a more complete data base would be available. Having all data together may facilitate performing useful analyses which have not been done, or perhaps not yet conceived, because assembling all

data was previously impractical. A central system would remove burdens on resources of each agency when requests for data are received from outside, and in some cases, increase the efficiency with which an agency responds to requests requiring recall and evaluation of climate data. The increasing trend toward automation and computerization in data handling by each agency is conducive to a computerized central storage system. Almost all agencies interviewed were enthusiastically in favor of a central storage system. None were opposed.

Some concerns were expressed over the establishment of a central storage system. Time and effort involved in standardizing and computerizing past records can in some cases be considerable. Design of present data handling systems for most agencies is geared towards efficient internal availability of data. An imposed storage scheme could introduce constraints which may reduce this efficiency. In cases where data are already archived and published, for example at the Protection Branch of Alberta Forestry Service, the contribution of data to a central storage system would involve duplication of effort. The usefulness of a central storage system to any agency would be reduced if it works with parameters which may be considered too non-standard to be included in the system. Problems may arise concerning priority assignment by system operators to data requests by individual agencies.

The above are some concerns which should be addressed in evaluating the feasibility of a central storage system. They can all be overcome if taken into account when designing the system.

4.3 DESIRED FEATURES OF A CENTRAL STORAGE SYSTEM

Comments and suggestions by personnel from each agency describing important features of a central storage system are summarized in this section.

The central storage system would operate with a mandate to provide archiving and retrieval services to provincial collectors of climate data. Complete cataloguing and documentation for all data

should be readily available. Reformating of data from each agency to common formats of the system should be a task of the system itself and not of the agencies. Quality control measures should not be imposed by the system; rather, a flagging scheme could be implemented to identify data of various documented levels of quality control. Flags could also be used to restrict access if cases exist where use of data should be made only in consultation with the contributing agency.

The system should offer facilities to search, sort, inspect, and edit data for individual user purposes. A user-routines library should be included for performing routine manipulations of data. This library could contain routines to prepare data for publication.

Design of the system should be user-oriented. Users should be able to access data without having an extensive background in computer technology. Security measures to prevent user foul-up should be built in. A personable systems analyst should be available to assist users if problems do arise.

Suggested operational aspects of the system include: fast response time; remote online access; facilities for hard copy and soft copy output; flexibility in data retrieval (e.g., requests for data by agency, parameter, location, time period, or all these criteria); and frequent updates of the main data file from collection systems.

Design features summarized above represent an integration of ideas presented by each agency. There were no directly conflicting suggestions on design. Any differences which may arise could be accommodated if taken into account when designing the system.

4.4 POTENTIAL INTERACTION BETWEEN A PROVINCIAL CENTRAL STORAGE SYSTEM AND THE CANADIAN CLIMATE CENTRE ARCHIVE

It is useful to examine potential interaction between a provincial central storage system and the archive of climate data

maintained by the Canadian Climate Centre (CCC), which is administered by the federal Atmospheric Environment Service.

The archive contains information observed hourly at all synoptic stations in Canada, information observed daily at all climate stations, and other miscellaneous information. Synoptic data are entered to the archive electronically with a link between the computer and the teletype communication system. All other data are keypunched. Quality control is done both manually and by computer. Files in the archive are updated about once per year. Data in the archive are presently accessed with batch job requests, although there are plans to implement a system of direct access. The CCC operates with 29 people in head office and one in each of the 6 regional offices. Five people in head office are employed in data distribution. Two of these are involved in maintaining the computer files and one in distribution of computerized data. The remaining two look after data not in computer form.

At the present time the CCC archives only data referred to as standard data. Although not formally defined, standard data include common AES synoptic parameters observed with regular frequency, using recommended instrumentation, through programs which are adequately documented and have been in operation for a significant period of time. Estimates of the amount of standard data collected by government agencies within Alberta is only about 25 percent.

The importance of non-standard data is recognized by AES, and in the future it will be included in the archive. Incorporation of non-standard data requires extensive planning, and AES is currently examining all related aspects.

Recommendations by AES to bodies establishing a regional archive of non-standard data are to maintain complete documentation of all data in the archive, and to store information in a format similar to that used by AES. Advantages of maintaining complete documentation have been elaborated on in previous sections. There are many advantages to using AES formats in archiving. The format

structure is flexible so that a wide variety of parameters may be accommodated. Data could be analysed using computer programs developed by AES. Both provincial and federal data could be analysed together with fewer data management complications. Inclusion of provincial data in the federal archive would be facilitated much more easily, and would be less labor intensive once the decision were made to do so.

5. SUMMARY AND RECOMMENDATIONS

A survey of collectors and users of climate data within provincial government agencies in Alberta has been undertaken. This survey shows that 13 agencies are independently involved in the collection of climate data. Data management systems by these agencies are not well developed. Programs for communicating information on collection programs and making data easily accessible do not exist at the present time. The need for such programs has been generally endorsed by both collectors and users of climate data. This need is reinforced by an anticipated increase in climate data collection activities.

Convenient and timely access to climate data will enable government agencies and the private sector to make use of climate factors in environmentally related decisions. Access to climate data by private citizens and corporations should merit consideration as funding of existing collection programs is drawn from the private and public sectors.

It is therefore recommended that the provincial government take steps to encourage the establishment of a data management system for storage and retrieval of climate data collected by all government agencies. There are several ways in which such a system may be implemented. These include:

1. Each agency independently implementing a system of its own design for storage and retrieval of data in a format most consistent with its internal data handling procedures;
2. Each agency independently implementing a system of uniform design for storage and retrieval of data in a format consistent among all agencies;
3. A single agency being given a mandate to implement a central storage system which would handle all aspects of data archiving, including conversion of data to common formats, storage, retrieval, and distribution.

A study should be initiated to examine in detail advantages, disadvantages, and cost-effectiveness of these and any additional alternatives. Study results would provide financial justification for courses of action appropriate for ministerial decision making.

6. REFERENCES CITED

Leggat K.R., B.L. Magill, N. VanWass, and H.S. Sandhu 1981. The impacts of climate change and variability on Alberta's resources and environment. Pages 12-24 in Climate change seminar proceedings. 1981 March 17-19; Regina, Saskatchewan Downsview, Ontario: Canadian Climate Centre. 170 pp.

7. APPENDIX

INTERVIEW GUIDE
(1.0)

INVENTORY OF ALBERTA GOVERNMENT CLIMATE
DATA COLLECTION PROGRAMS AND FUTURE CO-ORDINATION

The purpose of this study is to identify which Provincial Government agencies collect climatic data and to determine the feasibility and necessity of co-ordinating the various collection programs.

Format of interview:

- overview
- list of questions
- additional comments

Respondent
Position
Agency
Telephone

1. Please describe briefly the main purpose or purposes for collection of climatic data by your agency.

   i.e. routine monitoring
   research
   other (please specify)

2. What types of data are presently being collected by your agency, and how are they being collected? Specifically we are interested in:

   a) Climate variables observed (a non-exhaustive list is included on last page)
   b) Frequency of observation for each variable
   c) Type of instrumentation for each variable
   d) Number of observation sites
   e) Location of observation sites
   f) Length of record for each site
   g) Any changes and dates of changes in observation program

3. a) Do you have documentation for the information in question 2?

   Yes
   No

   b) If yes, documentation of all aspects of question 2 would be appreciated.

4. a) Is your agency storing data which are being collected by other organizations?

Yes
No

b) If yes, which organizations?

c) Can you re-respond to questions 2 and 3 for these data as completely as possible?

d) What fraction do these data contribute to all data your agency stores?

5. a) Do you anticipate any future changes in the amount of data collected by other organizations that you store?

Yes
No

b) If yes, what changes are anticipated?

6. Please describe briefly how each climatic variable relates to your purpose as given in question 1?

7. How is data relayed from observation sites to analysis site?

i.e. strip chart
cassette tape
telelephone line
satellite communication
etc.

8. a) Do you anticipate any changes to this system in the future?

Yes
No

b) If yes, what are they?

9. Once the data are obtained, how are they analyzed? Specifically we are interested in:

a) Any abstracting, preprocessing or analysis required before data can be used for your original purpose?

Yes
No

b) If yes, briefly explain what is done?

c) How are the data handled for this?

10. a) Do you plan any changes to this system in the future?

Yes
No

b) If yes, what changes are anticipated?

11. From your point of view, what are the main advantages and disadvantages in your data handling system?

12. Do you have any suggestions for streamlining your present data handling system?

13. How often do you use the data?

i.e. only initially after it is observed
for special studies
for statistical evaluation of the past
etc.
if necessary, please elaborate.

14. a) In what mode are your data filed after their initial use?

i.e. original form
hand tabulation
computer tape
etc.

b) What format is used in filing?

Documentation of modes and formats would be appreciated.

15. a) Do you anticipate any changes to this system in the future?

Yes
No

b) If yes, what changes do you anticipate?

16. From your point of view, what are the main advantages and disadvantages of your filing system?

17. Do you have any suggestions for streamlining your data filing system?

18. a) Do you receive requests for data from other government agencies, or from people or companies outside of the government?

Yes
No

If yes, we are interested in:

b) from who?
c) briefly for what purpose?
d) how often are these requests received?
e) in what format is data made available?
f) any documentation on your data retrieval and distribution system or data format would be greatly appreciated

19. a) Does your agency use data obtained from other government agencies?

Yes
No

If yes, we are interested in:

b) from what agency?
c) what type of data?
d) briefly for what purpose?
e) how frequently?
f) in what format do you receive the data?

20. a) From the perspective of your agency, do you have any immediate needs which require climatic data?

b) If yes, can you briefly describe the needs and data requirements?

21. a) Would you be in favour of establishing a common data bank for storage and retrieval of climatic data collected by various government agencies?

Yes
No

b) Why, or why not?

22. If such a system were established, what aspects in design would be most important to you?

23. a) Would you or your agency be willing to contribute your data to a common data bank using required formats, as a final step in routine data handling?

Yes
No

b) If no, why not?

24. a) Would you or your agency be willing to contribute all your filed data to a common data bank?

Yes
No

b) If no, why not?

c) What tasks would have to be performed to prepare your data?

d) What manpower requirements would be necessary to prepare your data?

e) Would you or your agency be able to contribute all or part of the resources necessary to accomplish this?

25. a) Are you aware of any other people or agencies who could provide information on any of the topics discussed in this interview?

Yes
No

If yes,

b) What agencies or whom?

c) Briefly what type of information would they have?

26. Please give any additional comments you may have concerning any aspect of this interview.

27. If, after reflecting on topics discussed in this interview, you have any additional information or ideas, please contact us or send them to us, before March 31, 1983 at:

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On behalf of the Research Management Division, thank you very much for your co-operation.

Martin Hansen
Mike Jones

METEOROLOGICAL PARAMETERS

- solar radiation
  - reflected
  - direct
  - net
- cloud cover
- visibility
- pressure
- dewpoint
- horizontal wind direction
- horizontal wind speed
- dry bulb temperature
- wet bulk temperature
- relative humidity
- cloud opacity
- cloud amount
- precipitation
- sunshine
- maximum daily temperature
- minimum daily temperature
- temperature gradients
- vertical wind direction
- vertical wind speed
- horizontal wind direction fluctuations
- vertical wind direction fluctuations
- convective mixing height
- mechanical mixing height